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ORIGINAL SUBMISSION

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February 16, 2001

Alan Rulis, Ph.D.
Office of Premarket Approval
(HFF-200)
Center for Food Safety and Applied Nutrition
Food and Drug Administration
200 C Street SW
Washington, DC 20204

Dear Dr. Rulis:

In accordance with proposed 21 CFR § 170.36 (Notice of a claim for exemption based on a GRAS determination) published in the Federal Register (62 FR 18939-18964), I am submitting in triplicate, as the agent to the notifier, Thixo Limited, 2 Hashaked Street, Ness Ziona, 74104 Israel, a GRAS notification of stearyl alcohol acid for use as a texturizer in certain, specified fats and oils, a GRAS panel report setting forth the basis for the GRAS determination and CV's of the members of the GRAS panel for review by the agency.

Sincerely,

W. Gary Flamm, Ph.D., F.A.C.T., F.A.T.S.

I. GRAS Exemption Claim

A. Claim of Exemption From the Requirement for Premarket Approval Pursuant to Proposed 21 CFR § 170.36 (c)(1)

Stearyl alcohol has been determined to be generally recognized as safe, and therefore, exempt from the requirement of premarket approval, under the conditions of its intended use as described below. The basis for this finding is described in the following sections.

Signed,

Date 2/16/01

W. Gary Flamm, Ph.D., F.A.C.T., F.A.T.S.

Agent for:

Thixo Limited
2 Hashaked Street
Ness Ziona, 74104 Israel

B. Name and Address of Notifier

W. Gary Flamm, Ph.D., F.A.C.T., F.A.T.S.
Flamm Associates
622 Beachland Blvd.
Vero Beach, Florida 32963
Telephone: 561-234-0096
Facsimile: 561-234-0026

C. Common Name of the Notified Substance

Stearyl alcohol.

D. Conditions of Use

Stearyl alcohol is intended to be used as an oil structuring and solidifying agent (texturizer as defined by 21 CFR § 170.3(o)932)) in margarine, shortening and foods typically requiring the use of semi-solid and solid fats at levels of up to 10% of the oil mass of the food item. The estimated mean and 90th percentile intake of stearyl alcohol by the total population from all proposed food uses of stearyl alcohol in the United States was determined to be 0.86 and 1.72 g/person/day. These exposure estimates are much lower than the current mean total intake of stearic acid for the total population based on the USDA CSF II 1994-1996 consumption survey data, 6.4 g/person/day.

E. Basis for the GRAS Determination

Pursuant to 21 CFR § 170.30, stearyl alcohol has been determined to be GRAS by scientific procedures. This determination is based on the views of experts who are qualified by scientific training and experience to evaluate the safety of ingredients used in food. The safety of stearyl alcohol is supported by a number of published studies including metabolic studies, acute, and medium-term toxicity studies in experimental animals, mutagenicity studies, and clinical studies on the nutritional effects of stearyl alcohol. In addition, the GRAS status of stearyl alcohol is supported by numerous published studies regarding the safety of its known metabolic product, stearic acid, and the related compound stearyl citrate which is readily metabolized to stearyl alcohol. This determination is further supported by a published safety assessment of stearyl alcohol by the Cosmetic Ingredient Review Expert Panel and a safety evaluation of stearyl alcohol as a food ingredient by the Select Committee of GRAS Substances for its current food uses. (See attached – EXPERT PANEL REPORT CONCERNING THE GENERALLY RECOGNIZED AS SAFE STATUS OF STEARYL ALCOHOL FOR USE IN SHORTENING, MARGARINE, AND FOODS TYPICALLY CONTAINING SEMI-SOLID AND SOLID FATS).

F. Availability of Information

The data and information that serve as a basis for this GRAS determination are available for the Food and Drug Administration's (FDA) review and copying at a reasonable time at the offices of:

W. Gary Flamm, Ph.D.
Flamm Associates
622 Beachland Blvd.
Vero Beach, Florida 32963
Telephone: 561-234-0096
Facsimile: 561-234-0026

Alternatively, copies of data and information can be provided to FDA upon request, by contacting Dr. Flamm.

II. Detailed Information About the Identity of the Substance

A. Identity

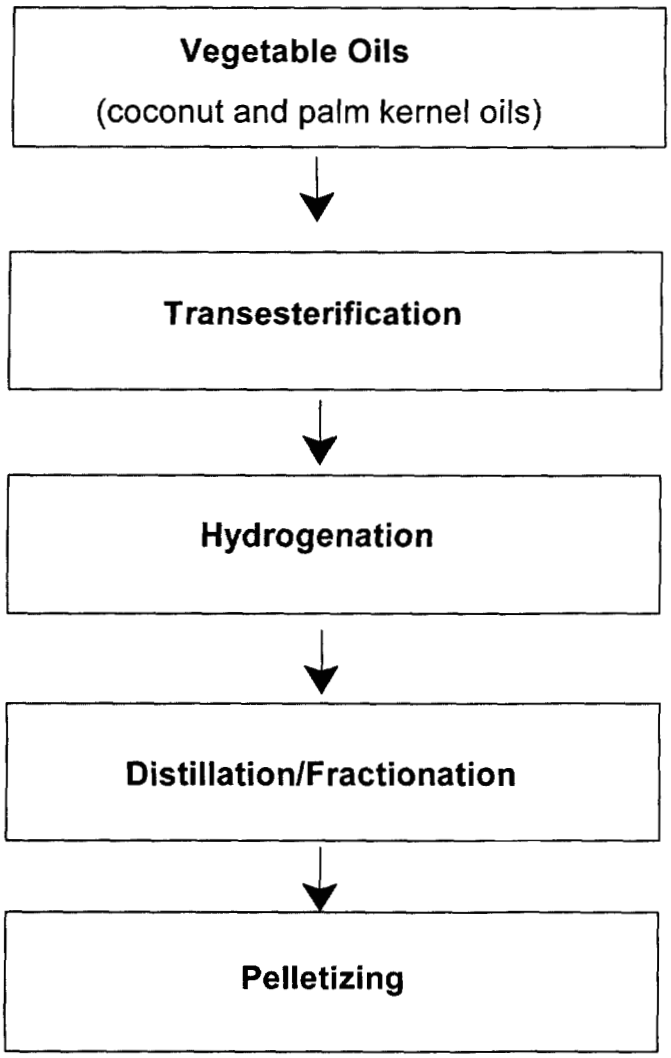
Stearyl alcohol is a colorless saturated fatty alcohol with a very mild odor. It is soluble in alcohol, ether, benzene and acetone and insoluble in water (FASEB, 1980; Merck, 1996a). The melting point for stearyl alcohol is approximately 56 to 58°C and its specific gravity is 0.812.

Common or Usual Name: Stearyl alcohol
Chemical Name: 1-Octadecanol
Chemical Abstracts Service (CAS) Number: 112-92-5
Empirical Formula and Formula Weight: $C_{18}H_{38}0$ Molecular weight 270.4976
Structural Formula: $CH_3(CH_2)_{16}CH_2OH$

B. Method of Manufacture

Stearyl alcohol is manufactured by the transesterification and distillation of unrefined coconut and palm kernel oil in the presence of methanol and a zinc catalyst followed by hydrogenation of the resulting methyl esters in the presence of a copper catalyst. Copper catalysts, as well as chromium and nickel catalysts, are typically used during the hydrogenation phase in the manufacture of fatty alcohols (21 CFR 172.864). Both catalysts are removed during the fractional distillation phases of the manufacturing process, as confirmed by the lack of heavy metals in the final product (less than 10 ppm heavy metals). The manufacturing procedures are commonly used in the edible fat industry, and the materials involved are appropriate for food use.

Figure 1. Manufacturing Scheme for Stearyl Alcohol



C. Specifications for Food Grade Material

Specifications and Analytical Methods for Stearyl Alcohol		
Specification Parameter	**Specification**	**Analysis Method**
Acid value	Not more than 0.1	ISO 660 [International Organization for Standardization; Animal and vegetable fats and oils - determination of acid value and acidity]
Saponification value	Not more than 0.5	ISO 3657 [International Organization for Standardization; Animal and vegetable fats and oils - determination of saponification value]
Hydroxyl value	205-210	DGF C-V 17a [German Standard Method; Determination with acetic anhydride]
Iodine value	Not more than 0.5	DGF C-V 11b [German Standard Method; Bestimmung der Jodzahl nach Kaufmann]
Solidification range (°C)	55-58	DIN ISO 3841 [International Organization for Standardization; Petroleum waxes- determination of melting point
Residue on ignition	< 0.01%	Limit Tests; Section 2.4.14 - European Pharmacopoeia
Heavy metals (as Pb)	Not more than 10 ppm	Limit Tests; Section 2.4.8- European Pharmacopoeia
Lead	Not more than 1 ppm	Limit Tests; Section 2.4.10 - European Pharmacopoeia
Chain distribution (%)		Gas chromatography [Internal method]
C 16	Not more than 4	
C 18	Not less than 95	
C 20	Not more than 3	

III. Self-Limiting Levels of Use

At varying levels exceeding 10% of the oil mass of certain food items, the characteristics of the food item would likely be altered. For example, some foods may become too hard at use levels higher than 10% and the texture, mouth feel, melting point, *etc.* of the product may be altered.

IV. Basis for GRAS Determination

The determination that stearyl alcohol is GRAS is on the basis of scientific procedures. See attached - EXPERT PANEL REPORT CONCERNING THE GENERALLY RECOGNIZED AS SAFE STATUS OF STEARYL ALCOHOL FOR USE IN SHORTENING, MARGARINE, AND FOODS TYPICALLY CONTAINING SEMI-SOLID AND SOLID FATS).

EXPERT PANEL REPORT CONCERNING THE GENERALLY RECOGNIZED AS SAFE (GRAS) STATUS OF STEARYL ALCOHOL IN SHORTENING, MARGARINE, AND FOODS TYPICALLY CONTAINING SEMI-SOLID AND SOLID FATS

January 19, 2001

Introduction

At the request of Thixo Limited, an Expert Panel of independent scientists consisting of Dr. W. Gary Flamm (Flamm Associates) and Dr. Ian Munro (CANTOX HEALTH SCIENCES INTERNATIONAL) conducted a comprehensive review of the pertinent data and information to determine whether specified uses of stearyl alcohol in food would be Generally Recognized As Safe (GRAS) in accordance with 21CFR§170.30, 21CFR§170.35 and proposed 21CFR§170.36. The *curriculum vitae* of each Panel member, which detail the scientific training and experience of each Panelist and provide evidence of their respective qualifications for evaluating the safety of food ingredients, is provided in Attachment 1.

The Panel critically evaluated a comprehensive package of publicly available scientific information and data compiled from the literature and other published sources. In addition, the Panel evaluated other information deemed appropriate or necessary including data and information provided by Thixo Limited. This included information pertaining to the method of manufacture and product specifications, analytical data, intended use levels in specified food products, and exposure estimates.

Following independent, critical evaluation of the data and information, the Panel concluded that stearyl alcohol, meeting appropriate food grade specifications and manufactured in compliance with current Good Manufacturing Practices, is "Generally Recognized As Safe" (GRAS) based on scientific procedures for the conditions of intended use described herein. A summary of the basis for this conclusion is provided below.

Background

Semi-solid and solid fats are typically produced through hydrogenation of vegetable oils which results in the formation of saturated fats and trans fatty acids, both of which are associated with elevated serum LDL cholesterol levels and increased risk of heart disease. These fats are also present in certain animal and plant-derived fats. Stearyl alcohol ($CH_3(CH_2)_{16}CH_2OH$) is a colorless, solid saturated fatty alcohol with a melting point of approximately 56 to 58^{0}C. Given these physical properties, a limited addition of stearyl alcohol to oil permits the production of semi-solid and solid fats without the need for hydrogenation.

Manufacturing and Specifications

Stearyl alcohol is manufactured by the transesterification and distillation of unrefined coconut and palm kernel oil in the presence of methanol and a zinc catalyst, followed by hydrogenation of the resulting methyl esters in the presence of a copper catalyst. Copper catalysts, as well as chromium and nickel catalysts, are typically used during the hydrogenation phase in the manufacture of fatty alcohols (21 CFR 172.864). The manufacturing process for stearyl alcohol complies with Good Manufacturing Practices (GMP), the procedures are commonly used in the edible fat industry, and the materials involved are appropriate for food use. Specifications are provided in attached Table 1.

Current and Proposed Uses

Stearyl alcohol is approved for use as a direct food additive (multipurpose additive) for use in food and in the synthesis of food components (21CFR 172.864). It also has indirect food additive uses (*e.g.*, as a component in coatings of cans or paper and paperboard that contact fatty and aqueous food) and is frequently used in cosmetic products as an emollient, stabilizer, antifoaming agent, emulsifier and carrier and as an inactive ingredient in drug products.

Stearic acid, the primary metabolic product of stearyl alcohol, is a principle constituent of most commercially hydrogenated fats and mammalian tissues and is a direct food additive affirmed as GRAS by the US FDA (21CFR 184.1090) for use as a flavoring agent and adjuvant. Based on the USDA CSF II 1994-1996 consumption survey data, mean total intake of stearic acid for the total population is 6.4 g/person/day. Stearyl citrate, a related compound, is permitted for use in food as an antioxidant, emulsifier and emulsifier salt, sequestrant, surface-active agent and for use in margarine, non-alcoholic beverages, and in fats and oils with no limitation other than current good manufacturing practice (21CFR 184.1851).

Stearyl alcohol is intended for use as an oil structuring and solidifying agent (texturizer) in margarine, shortening, and foods containing semi-solid and solid fats, at levels of up to 10% of the oil mass of the food item.

Exposure Estimates

The consumption of stearyl alcohol from the intended uses was estimated using published information on 1-day nutrient (total fat) intake data, and published survey data indicating that (1) the consumption of added fats and oils constitutes up to 47.6% of total fat consumption, and (2) that the intake of margarine and baking and frying fats constitutes 47.8% of total added fats and oils consumption. Stearyl alcohol will compete with technologies that have already been developed to lower the *trans* fat content of foods and thus will not capture 100% of the market. For example, TransEND® trans-free solid shortenings have been developed for use in baked goods, muffins, spreads, cakes, doughnuts, granolas, crackers, pies, *etc.*, and low or *trans*-free margarines and spreads such as Promise, Smart Beat, Fleischmann's lower fat margarine, and

Spectrum Naturals spread are also available in the market. Furthermore, future industry initiatives to continually reduce the *trans* fat content of the diet are highly likely given the known adverse health effects associated with a high *trans* fat diet. In addition, not all applications for the alcohol will be successful leaving many hydrogenated products on the market. Therefore, stearyl alcohol could reasonably be expected to capture approximately one-third of the market. An over-estimated market share of 50% was used in estimating exposure to stearyl alcohol. The estimated mean and 90th percentile intake of stearyl alcohol by the total population from all proposed food uses of stearyl alcohol in the United States was determined to be 0.86 and 1.72 g/person/day. A summary of stearyl alcohol consumption under the intended uses in food is provided in attached Table 2.

Safety

The Expert Panel critically evaluated the existing metabolic, toxicological and nutritional studies pertaining to the safety of stearyl alcohol. Mutagenicity studies and supporting toxicological data and information on stearyl citrate and stearic acid also were considered.

Metabolism

Following absorption (55 to 89%), approximately 90% of absorbed stearyl alcohol is converted enzymatically to its corresponding acid, stearic acid, in the intestinal mucosal cells (Calbert *et al.,* 1951; Sieber *et al.,* 1974; CIREP, 1985; Lington and Bevin, 1994; JECFA, 1998). Absorbed stearic acid is taken up from the blood and oxidized through -oxidation to serve as a source of energy. Stearic acid that is not oxidized in the liver is generally incorporated into triacylglycerols, phospholipids, lipid ethers or waxes or is converted back to stearyl alcohol (Sieber *et al.*, 1974; Friedberg, 1976; FASEB, 1980). As such, stearyl alcohol is metabolized to an endogenous, innocuous metabolite, which then serves as an energy source.

Three dogs were fed 29.1 g stearyl citrate in the diet over a period of 12 days (Calbert *et al.*, 1951). Approximately 186 to 225 mg of stearyl alcohol was reported in the feces of each animal indicating that stearyl citrate is hydrolyzed to stearyl alcohol prior to absorption.

Toxicological Studies

Stearyl alcohol, stearic acid, and stearyl citrate are all reported to have a very low order of acute oral toxicity (LD_{50} values of greater than 5 to 20 g/kg body weight) (Deuel *et al.*, 1951; Egan and Portwood, 1974; Gosselin *et al.*, 1976; Moreno, 1977; Sax, 1979; Guilian and Naibin, 1998).

Nine to 10 female rats (strain not specified) were fed either 1.8 or 7.5 g stearyl alcohol/kg body weight/day for 13 days (Calbert *et al.*, 1951). The high-dose animals lost weight during the course of the study; however, these animals consumed approximately half the amount of fat as the low-dose group (8.4 *versus* 15.5 g fat, respectively). No treatment-related effects were reported.

Other studies, investigating the nutritional value of stearyl alcohol in rats and its potential to induce encephalomalacia in Leghorn chicks, reported no mortalities, signs of toxicity or treatment-related adverse effects from the consumption of 8 to 10 g stearyl alcohol/kg body weight/day for 3 to 4 weeks (Miyazaki, 1955; Yoshida and Hoshii, 1971).

Groups of 6 mice were fed stearic acid at levels of 5 to 50% of the diet for 3 weeks (Tove, 1964). Weight gain decreased at dietary levels greater than 10% in comparison to controls and some animals were emaciated due to a depletion of the adipose tissue. No gross abnormalities were reported.

Deuel *et al.* (1951) reported the findings of a series of toxicity studies conducted with stearyl citrate. No effects were reported on feed consumption or weight gain in groups of 10 rats/sex fed diets containing up to 10.0% stearyl citrate for 6 weeks. In a separate experiment reported by this group, no differences in growth were reported in groups of 38 rats receiving either unheated margarine, margarine heated for 8 continuous hours at 205^{0} C, heated margarine with 0.86% stearyl citrate, or potato chips fried in margarine containing the citrate (0.68% stearyl citrate) in the diet.

Groups of 8 male rabbits received either a control diet or diets containing 2 or 10% stearyl citrate for 6 weeks (Deuel *et al.*, 1951). No treatment-related effects on growth or adverse findings from histopathological examination of the liver, kidney, heart, brain, lung, spleen, stomach, small intestine, large intestine, pancreas, adrenal and testes of the control and high-dose animals were reported. The no-observed-effect level (NOEL) corresponded to 10% in the diet; the highest dose tested.

Two groups of 4 dogs were fed either a control diet or a diet containing 3% stearyl citrate for 12 weeks (Deuel *et al.*, 1951). No differences between the 2 groups were reported in food consumption or weight gain, or in hemoglobin levels at the end of the study period. Histopathological examinations conducted on the livers and kidneys of these animals revealed no pathological findings.

Groups of 9 or 10 rats/sex were fed diets containing up to 10.0% stearyl citrate for 2 years (Deuel *et al.*, 1951). No statistically significant differences were reported in body weight gain and histopathological examination of selected tissues and organs of the control and high-dose groups revealed no treatment-related pathological findings. The no-observed-adverse-effect level (NOAEL) corresponded to 10% stearyl citrate in the diet (equal to 5,000 mg/kg body weight/day); the highest dose tested. The Joint FAO/WHO Expert Committee on Food Additives (JECFA) allocated an ADI of 50 mg/kg body weight/day for stearyl citrate for its use as an emulsifier and sequestrant in foods based on this NOAEL and a safety factor of 100 (JECFA, 1974).

Groups of 14 to 15 weanling male and female rats consumed diets containing 0, 1.9, or 9.5% stearyl citrate for 10 weeks in a multi-generation study (Deuel *et al.*, 1951). At 13 weeks of age, the rats were mated and maintained on these diets throughout pregnancy and lactation. The second generation was weaned at 3 weeks and continued to consume the same diet that their parents had. The study concluded with the weaning of the 5th generation. No adverse effects were reported on the number of litters, litter size, fertility, lactation, body weight, or growth of the pups. Body weights in the young were slightly higher in the experimental groups in comparison to the controls. The NOAEL corresponded to the highest dose tested, 9.5% stearyl citrate in the diet (equal to approximately 5,000 mg/kg body weight/day).

Based on the structure and metabolism of stearyl citrate, the NOAEL of 5 g/kg body weight/day, or 300 g/person/day, for stearyl citrate corresponds to 240 g/person/day for stearyl alcohol which is approximately 140 times greater than the estimated 90th percentile intake of stearyl alcohol from its proposed use.

Mutagenicity Studies

The mutagenic potential of stearyl alcohol was evaluated in the Ames assay using *Salmonella typhimurium* strains TA 98, TA 100, TA 1535 and TA 1537 and a strain of *Escherichia coli* (WP2uvrA) using concentrations of up to 10 mg/plate (SRI International, 1971; Florin *et al.*, 1980; Hachitani *et al.*, 1981; Blevins and Taylor, 1982; Prival *et al.*, 1991). No evidence of toxicity or mutagenic activity was reported at concentrations of up to 10 mg/plate, with or without metabolic activation (S9 fraction). Stearyl alcohol also tested negative in a mouse bone marrow micronucleus assay at doses of up to 1.45 g stearyl alcohol/kg body weight (Hachitani *et al.*, 1981).

Stearic acid tested negative in Ames assays using *S. typhimurium* strains TA 98, TA 100, TA 1535 and TA 1537 and a strain of *E. coli* (WP2uvrA) at concentrations 1 to 1,000 g/plate, with and without metabolic activation (Parry *et al.*, 1981; Blevin and Taylor, 1982; Shimizu *et al.*, 1985) and in an assay investigating its ability to induce mitotic aneuploidy and chromosomal cross-overs in the D6 strain of the yeast *Saccharomyces cerevisiae* at 500 g/ml (Parry *et al.*, 1981).

Nutritional Studies

The Panel is aware that saturated fatty acids such as palmitic, lauric and myristic acid have long been associated with increased serum cholesterol levels and considered studies relating the intake of stearic acid to serum total, HDL- and LDL-cholesterol levels. As outlined in the study summaries below, somewhat variable results have been reported in these studies; however, the majority of the studies provide evidence that stearic acid intake lowers cholesterol levels in comparison to the shorter-chain fatty acids such as palmitic acid and collectively indicate that stearic acid intake is not strongly associated with an increase in cholesterol levels.

Denke and Grundy (1991) investigated the effects of fats high in stearic acid in 10 male inpatients of a metabolic ward with an average pre-study plasma cholesterol level of 6.02±0.59 mmol/L. Each patient consumed a liquid containing either butter fat (4% of calories from stearic acid), beef tallow (7.6% of calories from stearic acid), cocoa butter (13.2% of calories from stearic acid) or olive oil (1.2% of calories from stearic acid), for 3 weeks each, in random order with a 1-week wash-out period of *ad libitum* eating. The olive oil and stearic acid-rich diets significantly lowered LDL cholesterol levels in comparison to the butter fat diet (3.62, 4.03 and 3.82 *versus* 4.24 mmol/L, respectively).

The effects of fats high in stearic acid (shea butter; 42% stearic acid), palmitic acid (palm oil; 43% palmitic acid) and myristic and lauric acid (palm-kernel plus sunflower oil; 10% myristic acid and 30% lauric acid) on lipoproteins were investigated in a randomized, controlled study for 3 weeks (Tholstrup *et al.*, 1994). Fifteen healthy young normocholesterolemic men were administered the diets for 3 weeks each with a 1 to 2 month washout period between diets. Total fat contributed 40% of energy with the test fat comprising 36% of this. In comparison to the palmitic acid-rich diet, the stearic acid diet significantly decreased plasma cholesterol by 22%, LDL cholesterol by 26%, HDL cholesterol by 12%, apolipoprotein B by 18%, apolipoprotein A-1 by 13% and factor VII coagulant activity by 13%. Similar significant reductions in lipid and lipoprotein concentrations occurred between the stearic acid-rich diet and the myristic/lauric acid-rich diet and habitual lipid levels.

In a 100-day cross-over study, 10 adult men consumed a 20-day stabilization diet before consuming a diet high in palmitic acid (7.3% of the energy as palmitic acid) and a diet high in stearic acid (7.3% of the energy as stearic acid), for 40 days each in random order (Dougherty *et al.*, 1995). All 3 diets provided roughly the same percentage of energy from carbohydrates, protein, and fat. In comparison to values at the end of the 20-day stabilization diet, total, LDL, and HDL cholesterol, and apolipoprotein A-I and B measures at day 20 and 40 were significantly lower in the high stearate diet group. Total, LDL and HDL cholesterol levels also were significantly lower in the high stearic acid diet group compared to the high palmitic acid diet group at day 20 of the test diet phase of the study.

In a similar study, 11 men were randomly administered liquid formulated diets containing fats rich in either palmitic acid (38.8%), stearic acid (42.9%) or oleic acid (79.7%) for 3 weeks each (Bonanome and Grundy, 1988). All 3 diets provided 40% of the calories as fat. The diet high in stearic acid resulted in total cholesterol and LDL cholesterol levels comparable to the high oleic acid diet and significantly lower than the palmitic acid-rich diet.

Fifty-six men and women consuming a diet in which 8% of energy was provided by stearic acid had significantly higher LDL-cholesterol levels than the subjects consuming a comparable linoleate diet as a result of a significant difference between the men in these 2 diet groups (3.16± 0.74 *versus* 2.90±0.71) (Mensink *et al.*, 1992). No significant differences in LDL-cholesterol levels were reported in the female groups.

In a multiple cross-over study, 26 men and 30 women randomly consumed 3 different experimental diets (diets providing 12.0% of the total energy intake from either linoleic acid or stearic acid, and a diet providing 7.7% of the total energy intake from monounsaturated fatty acids) for 3 weeks each (Zock and Katan, 1992). Total cholesterol and serum LDL cholesterol was lowest in the linoleic acid group and highest in the *trans* fatty acid group.

The plasma lipid effect of a stearic acid-rich triacylglycerol (34% stearic acid) and a palmitic acid-rich fat (32% palmitic acid) was investigated in 15 adult men and women with a pre-study average plasma cholesterol concentration of 6.13 mmol/L (Nestel *et al.*, 1998). The study subjects consumed a low fat diet for 2 weeks prior to consuming the 2 test fats (margarine) in random order and blinded fashion for 5 weeks each, in the form of margarine and biscuits and muffins containing the test fats. No significant differences were reported in plasma cholesterol, HDL or LDL cholesterol or plasma triglyceride levels among the 3 diets (low fat and test fat diets).

Ninety male patients with an average serum cholesterol level of greater than 232 mg/dL that had undergone clinically indicated coronary angiography for the investigation of angina pectoris or other manifestations of coronary artery disease (CAD) were tested in a study by Watts *et al.* (1995). Half of the patients received usual cardiological care (UC group) while the other half received this treatment in addition to repeated counseling on a lipid-lowering diet, supplementation with sources of soluble dietary fiber, and modest supplementation with omega-6 polyunsaturated fat (D group). Total fat content of the diet was 27% of dietary energy, 8 to 10% of energy was derived from saturated fatty acids, and dietary cholesterol was restricted to 100 mg/1,000 kcals.

Progression of CAD was reported to be associated with a higher intake of lauric, myristic, palmitic, and stearic acid and intake of saturated fat and LDL lipoprotein cholesterol levels were both independently associated with progression of CAD. After adjustment for confounding factors, intake of palmitic, stearic and elaidic acid were significantly associated with progression. At the end of the study, 46 and 15% of patients were reported to have angiographic progression and 4 and 35% of patients had angiographic regression in the UC and D groups, respectively. Higher intakes of the saturated fatty acids, oleic acid and elaidic acid were seen in the UC group.

In a 7 country cohort study, associations between intake of individual fatty acids and dietary cholesterol were studied in relation to serum cholesterol and 25-year mortality from CHD in 12,763 men (Kromhout *et al.*, 1995). Average saturated fatty acid intake was significantly associated with average serum cholesterol level and average intake of all major saturated fatty acids (lauric, myristic, palmitic, and stearic) was reported to be significantly associated with 25-year mortality rates from CHD. Changes in food production methods during the 25-year follow-up could have influenced the relative position of the cohorts in the distribution of different fatty acids. The saturated fatty acids lauric and myristic acid were more strongly related to population differences in serum cholesterol than palmitic and stearic acid despite the difference

not reaching statistical significance. Stearic acid intake may have been significantly associated with average serum cholesterol levels in this study due to a strong association between stearic acid intake and average intake of lauric, myristic, and palmitic acids. Independent effects of individual fatty acids could not be analyzed because mean intakes of individual saturated fatty acids, *trans* fatty acids and dietary cholesterol were strongly correlated among the 16 cohorts.

As indicated above, varying findings have been reported in studies investigating the effect of stearic acid intake on cholesterol levels; however, the weight of evidence from the available studies indicates that stearic acid is not strongly or positively associated with higher total or LDL cholesterol levels.

Conclusion

Based on critical, independent, and collective evaluation of the available data and information, we, as members of an Expert Scientific Panel, conclude that Thixo Limited's intended use of stearyl alcohol in food, meeting appropriate food grade specifications and manufactured in accordance with current Good Manufacturing Practices, is "Generally Recognized As Safe" ("GRAS") based on scientific procedures.

W. Gary Flamm, Ph.D., F.A.C.T. — Date 1/19/01

Ian C. Munro, Ph.D., F.A.T.S., FRCPath — Date Jan 26/01

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Table 1 Specifications and Analytical Methods for Stearyl Alcohol		
Specification Parameter	**Specification**	**Analysis Method**
Acid value	Not more than 0.1	ISO 660 [International Organization for Standardization; Animal and vegetable fats and oils - determination of acid value and acidity]
Saponification value	Not more than 0.5	ISO 3657 [International Organization for Standardization; Animal and vegetable fats and oils - determination of saponification value]
Hydroxyl value	205-210	DGF C-V 17a [German Standard Method; Determination with acetic anhydride]
Iodine value	Not more than 0.5	DGF C-V 11b [German Standard Method; Bestimmung der Jodzahl nach Kaufmann]
Solidification range (°C)	55-58	DIN ISO 3841 [International Organization for Standardization; Petroleum waxes- determination of melting point
Residue on ignition	< 0.01%	Limit Tests; Section 2.4.14 - European Pharmacopoeia
Heavy metals (as Pb)	Not more than 10 ppm	Limit Tests; Section 2.4.8- European Pharmacopoeia (Method D)
Lead	Not more than 1 ppm	Limit Tests; Section 2.4.10 - European Pharmacopoeia
Chain distribution (%)		Gas chromatography [Internal method]
C 16	Not more than 4	
C 18	Not less than 95	
C 20	Not more than 3	

Table 2 Summary of Estimated Daily Per Person Consumption of Stearyl Alcohol from Proposed Uses, in the US by Population Group			
Group	**Age Group (Years)**	**Consumption of Margarine and Baking/Frying Fats**	**Stearyl Alcohol Consumption**
		Mean (g/day)	**Mean (g/day)**
Infant	1 - 2	11.0	0.55
Children, male and female	3 - 5	13.2	0.66
Children, female	6 - 11	15.2	0.76
Children, male	6 - 11	17.1	0.86
Teenagers, female	12 - 19	15.9	0.80
Teenagers, male	12 - 19	23.6	1.18
Adults, female	20 and older	13.9	0.70
Adults, male	20 and older	21.3	1.07
All individuals	<1 and older	17.1	0.86

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EDUCATION

1970	Ph.D., Toxicology and Pharmacology, Queen's University, Kingston, Ontario, Canada
1967	M.Sc., Nutrition, McGill University, Montreal, Canada
1962	B.Sc., McGill University, Montreal, Canada

ACCREDITATION

1999	Fellow of The Academy of Toxicological Sciences
1988	Fellow of Royal College of Pathologists, London, England

EMPLOYMENT HISTORY

1999-Present	**University of Toronto,** Department of Nutritional Sciences, Faculty of Medicine. Toronto, Ontario. Professor.
1999-Present	**CANTOX HEALTH SCIENCES INTERNATIONAL,** Mississauga, Ontario. President.
1985-1999	**CanTox Inc.,** Mississauga, Ontario, Consultants in Health and Environmental Sciences. Consultant Toxicologist & Principal.
1983-1992	**Canadian Centre for Toxicology,** Guelph, Ontario, Canada. Director.
1981-1983	**Health and Welfare, Canada,** Food Directorate, Health Protection Branch. Ottawa, Canada. Director General.
1976-1981	**Health and Welfare, Canada,** Bureau of Chemical Safety, Food Directorate, Health Protection Branch, Ottawa, Canada. Director.
1975-1976	**Health and Welfare, Canada,** Bureau of Chemical Safety, Health Protection Branch, Ottawa, Canada. Chief, The Division of Toxicology.
1974-1976	**Health and Welfare, Canada,** Bureau of Chemical Safety, Health Protection Branch. Ottawa, Canada. Section Head, The Division of Toxicology.
1963-1974	**Health and Welfare, Canada,** Health Protection Branch, Ottawa, Canada. Research Scientist.

COMMITTEE MEMBERSHIPS

2000-	Member, Georgetown Dialogue Science Council, Georgetown University Center for Food and Nutrition Policy (CFNP)
2000-	Consultant, FEMA Expert Panel
1999	Center for Food Safety and Applied Nutrition (CFSAN) Research Program Committee, Food and Drug Administration
1998	Member, Minister's Advisory Board, Canadian Food Inspection Agency
1996	Chairman, Institute of Medicine, Subcommittee on Upper Safe Reference Levels of Nutrients
1996	Member, Ad Hoc Expert Panel, Life Sciences Research Office, Federation of American Societies for Experimental Biology (FASEB)
1993-	Member FAO/WHO Expert Committee on Food Additives
1989	Chairman, Expert Group to Develop a Threshold of Regulation for Indirect Food Additives
1989-1991	Member, Scientific Committee, International Food Biotechnology Council
1985-2000	Member, FEMA Expert Panel
1985	Member ILSI-NF, Nutrition and Safety Committee (FNSC)
1985	Member, NAS, Committee on Carcinogenicity of Cyclamates.
1984	Member, Committee on Food Chemicals Codex.
1983-1984	Member, Panel of Chemical Carcinogenesis Testing and Evaluation (National Toxicology Program)
1983	Member, The Nutrition Foundation Project on the Use of Mouse Hepatoma Data.
1981-1983	Expert Committee on the Relevance of Mouse Liver as a Model for Assessing Carcinogenic Risk, The Nutrition Foundation, Inc.
1981-1982	Expert Advisory Committee to The Nutrition Foundation, Inc., on the Assessment of the Safety of Lead and Lead Salts in Foods.
1981	Chairman, International Committee on Hazards Associated with Dioxin in the Great Lakes.
1981	Chairman, WHO Ad Hoc Meeting on the Future of Joint Expert Committees in the Context of the International Program on Chemical Safety, Geneva.
1980-1983	Chairman, Health Protection Branch/Food Industry Liaison Committee.
1980-1983	Chairman, Interdepartmental Committee on Canning Regulations.
1980	Member, Federal Interdepartmental Salmonella Committee.
1980	Member, Senior Level Committee (U.S., U.K., Canada).
1980	Member, International Life Sciences Institute Experts in Pathology and Toxicology.
1980	Member, Technical Committee: WHO International Program on Chemical Safety.
1978-1980	Expert Committee on Food Safety - Agriculture Canada
1978-1980	Food Safety Council, Social and Economic Committee.
1978-1979	U.S. National Academy of Sciences, Subcommittee on Risk Assessment - Safe Drinking Water Committee.
1978	Chairman, Tripartite Toxicology Committee (U.S., U.K., Canada).
1977-1981	International Commission for Protection Against Environmental Mutagens and Carcinogens (ICPEMC), subcommittee 3.
1977-1979	U.S. National Cancer Institute, Cause and Prevention Scientific Review Committee.
1976-1984	WHO/FAO Joint Expert Committee on Food Additives.
1976-1980	Food Safety Council, Toxicology Committee.
1976-1979	Canadian Council on Animal Care.
1976-1979	Interdepartmental Committee on Toxicology Needs in Canada.
1976-1978	National Research Council Task Force on Mercury and Captan.
1975-1976	U.S. National Academy of Sciences Committee on Toxicology
1975-1976	WHO/FAO Committee on Criterion Documents on the Toxicology of Environmental Chemicals.

EDITORIAL RESPONSIBILITIES

1982-1996	Editorial Board	Journal of the American College of Toxicology
1979-1991	Advisory Board	Neurotoxicology
1978-1989	Editorial Board	Journal of Environmental Pathology and Toxicology

PROFESSIONAL AFFILIATIONS

Professional Society Memberships:

Member, Society of Toxicology
Member, Toxicology Forum
Member, Society of Toxicology of Canada
Member, American College of Toxicology
Member, Institute for Risk Research
Member, International Society of Regulatory Toxicology and Pharmacology

Contributions to Professional Societies:

1981	Professional Standards Evaluation Board in General Toxicology, Academy of Toxicological Sciences
1978-1979	Society of Toxicology, Nominating Committee
1978-1979	Society of Toxicology, Finance Committee
1976-	Toxicology Forum, Inc., Board of Directors

AWARDS

1998	International Society of Regulatory Toxicology and Pharmacology "International Achievement Award" for his guiding role as Chairman of the Expert Panel of Members – "Interpretive Review of the Effects of Chlorinated Organic Chemicals".
1975	Society of Toxicology "Achievement Award" for outstanding contributions to the science of toxicology by an individual 35 years of age or younger.

SCIENTIFIC PUBLICATIONS AND MONOGRAPHS

Hoover, D., Chassy, B.M., Hall, R.L., Klee, H.J., Luchansky, J.B., Miller, H. I., Munro, I.C., Weiss, R., Hefle, S.L., and Qualset, C.O. 2000. Human Food Safety Evaluation of rDNA Biotechnology-Derived Foods. Institute of Food Technologists Expert Report on Biotechnology and Foods. Reprinted from Food Technol 54(9), September.

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Kraus, A.L., Munro, I.C., Orr, J.C., Binder, R.L., LeBeouf, R.A., and Williams, G.M. 1995. Benzoyl Peroxide: An Integrated Human Safety Assessment for Carcinogenicity. Regul Toxicol Pharmacol 21:87-107.

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Carlo, G.L., Cole, P., Miller, A.B., Munro, I.C., Solomon, K.R., and Squire, R.A. 1992. Review of a Study Reporting an Association Between 2,4-Dichlorophenoxyacetic Acid and Canine Malignant Lymphoma: Report of an Expert Panel. Regul Toxicol Pharmacol 16:245-252.

Nestmann, E.R., Munro, I.C., Willes, R.F., and Orr, J. 1992. Risk Assessment: An Overview. In: Canadian Environmental Directory. Second Edition. Canadian Almanac and Directory Publishing Company Ltd. pp 13-16.

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Munro, I.C. 1990. Safety Assessment Procedures for Indirect Food Additives: An Overview. Regul Toxicol Pharmacol 12(1):2-13.

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Clayson, D.B., Munro, I.C., Shubik, P., and Swenberg, J.A. (Eds) 1990. Progress in Predictive Toxicology. Elsevier Science Publishers.

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Zimmerman, R. Borzelleca, J., Crump, K., Doull, J., Gardner, D., Gardner, H., Hughes, D., Munro, I.C., Parke, D.M., Rodericks, J., Tardiff, R.G., and Travis, C. (Eds) 1990. Governmental Management of Chemical Risk. Lewis Publishers, Inc.

Munro, I.C. 1990. Sweeteners: Health Effects-Neoplasm Promotion. In: Williams, G.M. (Ed.) Sweeteners: Health Effects.

Munro, I.C. 1988. General Principles of Regulation of Nutrients. In: Middlekauf, R., and Shubik, P. (Eds.) Food Regulations: An International Handbook.

Munro, I.C. 1988. Risk Assessment of Carcinogens: Current Status and Future Prospects. Biomedical and Environmental Sciences.

Munro, I.C., Morrison, A.B. 1988. Pesticides. Nut Pharm Toxicol pp 187-196.

Munro, I.C. 1988. Qualitative Factors in Carcinogen Classification. In: Carcinogen Risk Assessment: New Directions in the Qualitative and Quantitative Aspects. Cold Spring Harbor Laboratory, Banbury Report 31.

Munro, I.C. 1987. Expert Panel Report on Carcinogenicity of 2,4-D. Canadian Centre for Toxicology, Guelph, Ontario, Canada.

Munro, I.C. 1987. International Perspectives on Animal Selection and Extrapolation. In: Roloff, M.V. (Ed.) Human Risk Assessment - The Role of Animal Section and Extrapolation.

Munro, I.C. 1986. The ingredients of foods: How they are tested and why they are selected. J Allerg Clin Immunol 78(1):133-139.

Munro, I.C. 1986. Overview of Recent Problems in Chemical Carcinogenesis. In: Chambers, P.L., Gehring, P., and Sakai, F. (Eds.) New Concepts and Developments in Toxicology. Elsevier Science Publishers, Amsterdam.

Clayson, D., Krewski, D., and Munro, I.C. (Eds.) 1985. Toxicological Risk Assessment. Volume I. CRC Press, Boca Raton, Florida.

Clayson, D., Krewski, D., and Munro, I.C. (Eds.) 1985. Toxicological Risk Assessment. Volume II. CRC Press, Boca Raton, Florida.

Arnold, D.L., Moodie, C.A., Charbonneau, S.M., Grice, H.C., McGuire, P.F., Bryce, F.R., Collins, B.T., Zawidzka, Z.Z., Krewski, D.R. Nera, E.A., and Munro, I.C. 1985. Long-term toxicity of hexachlorobenzene in the rat and the effect of dietary Vitamin A. Food and Chem. Toxicol., 9:779-793.

Munro, I.C., Goldberg, L., and Farber, E. 1985. Formaldehyde Risk Assessment. Report to Ontario Ministry of Labour.

Tryphonas, H., and Munro, I.C. 1984. Risk-Benefit Assessment in Immunotoxicology. In: Mullen, P.W. (Ed.) NATO ASI Series, Vol. G2 Immunotoxicology.

Clayson, D., Krewski, D., and Munro, I.C. 1984. The power and interpretation of the carcinogenicity bioassay. Regul Toxicol Pharmacol 3:329-348.

Munro, I.C. 1984. Risk Assessment and Environmental Regulation. Prepared for the ILSI Symposium on Safety Assessment, Tokyo.

Munro, I.C. 1984. Report to the Royal Commission to Inquire into the Use and Effects of Chemical Agents on Australian Personnel in Vietnam.

Arnold, D.L., Krewski, D.R., and Munro, I.C. 1983. Saccharin: A toxicologically and historically interesting sweetener. Toxicology 27:179-256.

Munro, I.C., Miller, C.T., Krewski, D. 1983. Regulatory control of environmental chemicals: A Canadian viewpoint. J Amer Coll Toxicol 2(1).

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Munro, I.C. 1977. The Importance of Specifications for Substances in Their Safety Evaluation in Foods. Prepared for the Scientific Committee of the Food Safety Council.

Munro, I.C. 1977. Working Papers for 34 Food Colors. Prepared for Joint FAO/WHO Expert Committee, Geneva.

Charbonneau, S.M., Munro, I.C., and Nera, E. 1977. Chronic Toxicity of Methylmercury in the Adult Cat. Proc. X Symposium on Trace Substances in Environmental Health, Columbia, Missouri.

Munro, I.C. 1976. Considerations in Chronic Toxicity Testing: The Chemical, The Dose, The Design. Presented at the Status of Predictive Tools in Application to Safety Evaluation Conference, November, Little Rock, Arkansas.

Munro, I.C. 1975. Working Paper on Nitrates, Nitrites and Nitrosamines. Prepared for the World Health Organization.

Grice, H.C., DaSilva, Stoltz, D.R., Munro, I.C., Clegg, D.J., and Abbatt, J.D. Testing of Chemicals for Carcinogenicity, Mutagenicity, Teratogenicity.

Munro, I.C. 1974. Chemicals that Cause Food Poisoning. Proc. of Symposium on Food Poisoning and its Significance in the Food Service Industry. Department of National Health and Welfare.

Stavric, B, Lacombe, R., Munro, I.C., and Grice, H.C. 1973. Studies on Chemical Impurities in Commercial Saccharin (Interim Report). Submitted to NRC Committee on Artificial Sweeteners of the National Academy of Sciences of the United States.

Munro, I.C., Moodie, C.A., and Grice, H.C. 1973. An Evaluation of the Carcinogenicity of Commercial Saccharin. Submitted to NRC Committee on Artificial Sweeteners of the national Academy of Sciences of the United States.

Munro, I.C., Charbonneau, S.M., and McKinley, W.P. 1973. Studies on the Toxicity of Methylmercury. Commission of the European Communities, Luxembourg.

Grice, H.C., DaSilva, T.,Stoltz, D.R., Munro, I.C., Clegg, D.J., and Abatt, J.D. 1973. Testing of Chemicals, Mutagenicity and Teratogenicity. Department of National Health and Welfare.

Munro, I.C., Hasnain, S., Salem, F.A., Goodman, T., Grice, H.C., and Heggtveit, H.A. 1972. Cardiotoxicity of Brominated Vegetable Oils. Myocardiology Volume I. Recent Advances in Studies on Cardiac Structure and Function. p 588.

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CURRICULUM VITAE

W. GARY FLAMM, Ph.D., F.A.C.T., F.A.T.S.

Former Director, Office of Toxicological Sciences
U. S. Food and Drug Administration

FLAMM ASSOCIATES
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Tel: FAX:

E-MAIL:

EDUCATION:

Doctor of Philosophy (Biological Chemistry, University of Cincinnati, Cincinnati, Ohio, 1959-1962.

Master of Science (Pharmaceutical Chemistry), University of Cincinnati, Cincinnati, Ohio, 1957-1959.

Bachelor of Science (Pharmacy), University of Cincinnati, Cincinnati, Ohio, 1953-1957.

PROFESSIONAL POSITIONS:

Consultant, Flamm Associates, 1988-present.

Director, Office of Toxicological Sciences, Center for Food Safety and Applied Nutrition, U.S. Food and Drug Administration (US FDA), 1984-1988.

Associate Director for Toxicological Sciences, Bureau of Foods, US FDA, 9/82 - 3/84.

Acting Associate Director for Toxicological Sciences, Bureau of Foods, US FDA, 5/82 - 9/82.

Acting Associate Director for Regulatory Evaluation, Division of Toxicology, Bureau of Foods, US FDA, 10/81 - 5/82.

Deputy Associate Commissioner for Health Affairs, US FDA, 5/81 - 10/81.

Acting Deputy Associate Commission for Health Affairs, US FDA, 7/80 - 7/81.

Associate Director for Regulatory Evaluation, Division of Toxicology, Bureau of Foods, US FDA , 11/78 - 7/80.

Assistant Director for Division of Cancer Cause and Prevention, National Cancer Institute, NCI, 9/74 - 10/77.

Chief, Genetic Toxicology Branch, Bureau of Foods, US FDA, 9/72 - 9/74.

Head, Somatic Cell Genetics Section, National Institute of Environmental Health Sciences, National Institutes of Health, 1/72- 9/72.

Research Chemist, Cell Biology Branch, National Institute of Environmental Health Sciences, National Institute of Health 6/68 - 1/72.

Sr. Research Fellow, Dept. of Zoology, University of Edinburgh, Edinburgh, Scotland, 9/66 - 7/68.

Research Chemist, National Cancer Institute, National Institute of Health, 7/64 - 9/66.

Research Fellow, California Institute of Technology, 6/62 - 7/64.

Predoctoral Fellow, Department of Biochemistry, University of Cincinnati, 9/59 - 6/62.

PROFESSIONAL SOCIETIES AND HONORS:

Fellow, Academy of Toxicological Sciences, 1999 -present

American College of Toxicology (Charter Member) 1977-present
- President, 1984-1985
- Fellow of the American College of Toxicology, since 1986
- Chairman, Program Committee 1983, 1984
- Membership Committee, 1979, 1981
- Program Committee, 1984-1985
- Nominee Committee, 1982-1983
- Council, 1982-1984
- Publications Committee, 1983-1984

Environmental Mutagen Society (EMS) (Charter Member) 1969-present
- Treasurer, 1973-1974
- Council, 1974-1976, 1978-1981

Executive Board, 1975-1976
Chairman, Program Committee, 1974
Chairman, Nomination Committee, 1978-979
Finance Committee, 1979-1980
Long-Range Planning Committee, 1979-1980

Society for Risk Analysis (Charter Member & Co-Founder) 1980-present
Secretary 1992-1997
Council 1988-1990
Program Committee, 1981-1982
President's Advisory Committee, 1981-1982
Membership Committee, 1988-1990

International Society for Regulatory Toxicology and Pharmacology, 1985-present
President, 1990-1992
Vice President, 1988-1990

The Toxicology Forum
Member 1992-present
Program Planning Committee – 1980-1994

Sigma Xi

Member, Federal Executive Institute Alumni Association, 1982

Former Member, American Chemical Society, Genetics Society of America,

Former Biophysical Society, American Pharmaceutical Association, Biochemical Society,

Former American Association for the Advancement of Science, New York Academy of Science, American Forestry Association

George Scott Memorial Award, Toxicology Forum, 1988

U.S. FDA Senior Executive Performance Award for Outstanding Performance during fiscal years 1980, 1982, 1983, 1984

Environmental Mutagen Society's Recognition Award, 1981. "For his accomplishments both in research and the administration of toxicology programs, especially for his untiring efforts to establish genetic toxicology as an essential component of chemical safety evaluation."

U.S. Department of Health, Education and Welfare Superior Service Award, 1977. "For vigorous leadership in reshaping the philosophy and methods for assessing environmental carcinogenic hazard to humans on a national and international scale.

Elected Class Representative to Senior Executive Training Program, 1980

U.S. Public Health Service Predoctoral Fellowships, 1962, 1963, 1964

Sigma Xi - honorary graduate

U.S. Public Health Service Predoctoral Fellowships, 1959, 1960, 1961, 1962

Rho Chi - honorary Pharmaceutical Society, 1958

Otto Mooseburger Award in Pharmacy, 1957

ADDITIONAL TRAINING:

Radiation Biology, University of Sao Paulo, Brazil, 1971

Molecular Biology, University of Edinburgh, Scotland, 1966-1968

Biochemical Genetics, National Institutes of Health, 1965-1966

Molecular Biology, Biophysics, California Institute of Technology, Pasadena, California, 1962-1964

Senior Executive Training Program, Federal Executive Institute, 1980

COMMITTEES, CHAIRMANSHIPS AND RESPONSIBILITIES:

Special Foreign Assignment to the University of Edinburgh, Edinburgh, Scotland, 1967-1968

Testimony before US Senate on "Chemicals and the Future of Man," 92nd Congress, Subcommittee on Executive Reorganization and Government Research, Washington, D.C., 1971

Organizer and Chairman "Methods for the Detection of Somatic Mutations in Man," NIEHS/NIH, Research Triangle Park, North Carolina, 1972

Executive Secretary - Subcommittee on Carcinogen Laboratory Standards, DHEW, 1973-1975

Chairman - Subcommittee on Carcinogenicity of NTA, Committee to Coordinate Toxicology and Related Programs, DHEW, Bethesda, Maryland, 1974-1975

Executive Secretary - National Cancer Advisory Board Subcommittee on Environmental Carcinogenesis, Bethesda, Maryland, 1975-1977

Chairman - Working group to develop document on "Approach to Determining the Mutagenic Properties of Chemical Substances," CCTRP, DHEW, 1975-1977

Preparation of testimony and hearing statements before NIH appropriation subcommittees of the Congress on cancer prevention for the National Cancer Institute, 1975, 1976

Preparation of testimony and appearance before U.S. Senate Health Subcommittee on Diethylstilbestrol Hearings, 1975

Member, DHEW Subcommittee on polychlorinated biphenyls, Bethesda, Maryland, 1975 Coordinated and participated in the interdepartmental HEW study on the toxicology and health effects of polybrominated biphenyl, 1975-1977

Chairman, Carcinogenesis Coordinating Committee, National Cancer Institute, Bethesda, Maryland, 1976-1977

Member of the FDA interagency committee to evaluate carcinogenicity of FD&C Red No. 40, Washington, D.C., 1976-1978

Testimony before a U.S. Congress on saccharin, House Health Subcommittee, 1977

Commissioner's Task Force on the 1977 National Academy of Sciences report on the National Center for Toxicologic Research, Rockville, Maryland, 1977-1978

Chairman, Cancer Assessment Committee, FDA/Bureau of Foods, Washington, D.C., 1978-1988

Chairman, Mutagenicity Working Group on Risk Evaluation, U.S. Environmental Protection Agency, 1978-1980

Chairman, Health Effects of Diesel Fuel Emission, U.S. Environmental Protection Agency, 1978

Testimony before U.S. House of Representatives, Committee on Science and Technology on Use of Animals in Medical Research and Testing, 1981

Member of Working Group on methods for the integrated evaluation of risks for progeny associated with prenatal exposure to chemicals - WHO/International Program for Chemical Safety 1981

Working Group on Carcinogen Principles, White House Office of Science Technology Policy, 1982

Testimony before a U.S. House of Representatives, Committee on Science and Technology, hearing on Hazards of Chemicals to Human Reproduction, 1982

Member, Risk Management Working Group, Interagency Risk Management Council, 1984, 1985

Co-chairman, U.S. FDA, Health Hazard Evaluation Board,1982-1988

Chair, Session on Mutagenesis, Annual Meeting of the American College of Toxicology, 1980

Chairman, Food and Risk Assessment, Mechanisms of DNA Damage and Repair: Implications for Carcinogenesis and Risk Assessment, 1985

Chair, Session on DeMinimus Risk, International Society of Regulatory Toxicology and Pharmacology, 1987

Chairman, Approaches to Validation, In Vitro Toxicology, sponsored by the Johns Hopkins Center for Alternatives to Animal Testing, 1986

Chair, Risk Analysis and the Food and Drug Administration, Society for Risk Analysis, Annual Meeting, 1988

Chair, Risk Assessment in the Federal Government: Managing the Process, Toxicology Forum, 1983

Chair, Program Committee, Annual Meeting of the International Society of Regulatory Toxicology and Pharmacology, 1987, 1988, 1989

Chair, Risk Assessment, Toxicology Forum, 1990

Ad Hoc Chair of Expert Panels on Generally Recognized as Safe Substances from 1990-present

FACULTY APPOINTMENTS:

Adjunct Associate Professor, Department of Zoology, University of North Carolina, Chapel Hill, North Carolina, 1968-1972

Visiting Professor of Biochemistry, University of Sao Paulo, Brazil, 1970 and 1971

Adjunct Professor of Genetics, George Washington University, Washington, D.C., 1972-1974

Visiting Professor, European Molecular Biology Organization, University of Zurich, Zurich, Switzerland, 1973

Visiting Professor, University of Conception, Chile, 1979

EDITORIAL AND ADVISORY ACTIVITIES:

Manuscript review for numerous journals, e.g., Biochem. Biophys. Acta, Science, Proc. Natl. Acad. Sci., J. Mol. Biology, J. Biochem, Genetics, Biochemical Journal, Expt. Cell Research, Cancer Research, J. Natl. Cancer Institute, Mutation Research, Radiation Research, Food and Chemical Toxicology, J. Toxicology and Environ, Health, Genetic Toxicology, CRC Reviews in Toxicology

Associate Editor, Journal of Environmental Health and Toxicology, 1974-1978

Section Editor, Journal of Environmental Pathology and Toxicology, 1978-1982

North American Field Editor, Teratogenesis, Carcinogenesis and Mutagenesis, 1994-present

Editorial Board, Genetic Toxicology, 1975-1978

Editorial Board, Food and Chemical Toxicology, 1977-1988

Editorial Board, Biomedical and Environmental Sciences, 1988-present

Sec. Ed., Journal of the American College of Toxicology, 1982-1996

Member of Editorial Board, Journal for Risk Analysis, 1982-1986

Member of Editorial Board, Regulatory Toxicology and Pharmacology, 1986-present

Co-editor, Advances in Modern Toxicology: Mutagenesis, 1976-1978

Co-editor, Carcinogenesis & Mutagenesis, Princeton Scientific Publishers, 1979-1981

Member, Genetics Program Committee, George Washington University, Washington, D.C., 1972-1975

Member, Joint Subcommittee on Mutagenicity, Pharmaceutical Manufacturers Association - Food and Drug Administration, Washington, D.C., 1972-1974

Member, Faculty Group, European Molecular Biology Organization, Geneva, Switzerland, 1973

Member, US/USSR Delegation to Moscow, Environmental Health Agreement, DHEW, 1974

Member, Scientific Advisory Board, National Center for Toxicological Research (NCTR), Jefferson, Arkansas, 1975-1978

Chairman, Subcommittee on Mutagenesis, Science Advisory Board, National Center for Toxicological Research, Jefferson, Arkansas, 1975-1978

Chairman, Subcommittee on Genetic and Environmental Influences on Carcinogenesis (matrix) Sci. Adv. Board, National Center for Toxicological Research, Jefferson, Arkansas, 1975-1978

Member, Toxicology Advisory Committee, Food and Drug Administration, Rockville, Maryland, 1975-1978

Member, National Academy of Sciences, Committee to Develop Principles for Evaluating Chemicals in the Environment, Washington, D.C., 1975

Chairman, Subcommittee on Tissue Culture Resources, Sci. Adv. Board, National Center for Toxicologic Research, Jefferson, Arkansas, 1976-1978

Member, National Academy of Sciences Committee to Revise Publication No. 1138, Toxicologic Evaluation of Household Products, Washington, D.C., 1976-1977

Chairman, Subcommittee on Mutagenesis of NAS committee to revise Publication No. 1138, Washington, D.C., 1976-1977

Member, National Academy of Sciences Visiting Committee to Review the Food and Nutrition Board, Washington, D.C., 1976-1977

Consultant, Organization of American States, Office of Scientific Affairs, Sao Paulo, Brazil, 1971.

Consultant, National Science Foundation, Structure and Function of Human Chromosome, Washington, D.C., 1971.

Advisor, National Science Foundation, Developmental Biology - Cell Biology, Washington, D.C., 1971-1972, 1978.

Consultant, World Health Organization, consultant group on anti-schistosomal agents, Geneva, Switzerland, 1972

Consultant, National Cancer Institute, Carcinogenesis Program, Bethesda, Maryland, 1972-1974

Consultant, Environmental Protection Agency, Washington, D.C., 1972-1973, 1976-1977

Consultant, Bureau of Drugs, Safety Evaluation, Rockville, Maryland, 1972-1974

Consultant, Consumer Product Safety Commission, 1973-1975, 1977

Consultant, National Institute on Drug Abuse, Rockville, Maryland, 1976-1977

Member, Faculty Group - International Course on Methods for the Detection of Environmental Mutagens, Concepcion, Chile, 1979

Chairman of the FDA's Recombinant DNA Coordinating Committee, 1980-1981

Co-Chairman Joint Committee on Agency-Wide Quality Assurance Criteria (FDA), 1980-1981

Chairman, Scientific Advisory Research Associates Program (FDA), 1980-1981

Chairman, International Visiting Scientific Program (FDA), 1980-1981

Chairman, Agency-Wide Research Review and Planning Group (FDA), 1981

Ex-Officio Member National Cancer Advisory Board, 1980-1981

Member, Interagency Regulatory Liaison Group on 1-Mutagenesis; 2-Cancer Risk, 1979-1981

Organizing Committee for First World Congress on Toxicology and Environmental Health, 1983

Organizing Committee for "Symposium on Health Risk Analysis", 1981

Chairman, Toxicology Committee, National Conference for Food Protection, 1985-1986

Member, NAS Committee on Biomedical Models, 1983-1985

INVITED PRESENTATIONS:

"Kinetics of Homogentisate Oxidase", Federation of American Societies of Experimental Biology, Atlantic City, New Jersey, 1961

"Histone Synthesis", invited speaker, First International Conference on Histone Chemistry and Biology, Santa Fe, California, 1963

"Free and Bound Ribosomes", FASEB, Chicago, Illinois, 1963

"Histone Synthesis" Seminar, California Institute of Technology, Pasadena, California, 1963.

"Association and Dissociation of RNP particles" Seminar, University of Cincinnati, Cincinnati, Ohio, 1963.

"Ribosome Synthesis", California Institute of Technology, Pasadena California, 1964.

"Protein and Nucleic Acid Biosynthesis", University of California, Santa Barbara, California, 1964.

Biosynthesis and Assembly of Ribosomes", Dupont Laboratories, Wilmington, Delaware, 1964.

"Isopycnic Density Gradient Centrifugation", University of Pennsylvania, Institute for Cancer Research, Philadelphia, Pennsylvania, 1965.

"Use of fixed-angle rotors" Seminar, Carnegie Institution of Washington, Washington, D.C., 1965.

"Conversion of 23S to 16S RNA", Biophysical Society, Boston, Massachusetts, 1965.

Participant at Gordon Conference on Cell Structure and Function, Meriden, New Hampshire, 1965.

"Turn-Over of Mitochondrial DNA" Seminar, National Cancer Institute, Bethesda, Maryland, 1966.

"Isolation and Fractionation of DNA", invited speaker, Symposium on Subcellular Fractionation, London, England, 1967.

"Isolation and Properties of Satellite DNA", University of Edinburgh, Scotland, 1967.

Properties of Mouse Satellite DNA", University of Glasgow, Glasgow, Scotland, 1967.

"Isolation of Complementary Strands from Mouse Satellite", Oxford University, Oxford, England, 1967.

"Highly Repetitive Sequences of DNA", St. Andrews University, St. Andrews, Scotland, 1968.

"Repetitive Sequences in Rodents", Department of Molecular Biology, University of Edinburgh, Edinburgh, Scotland, 1968.

"Satellite DNA from the Guinea Pig", Newcastle University, Newcastle, England, 1968.

"Isolation, Preparation, and Fractionation of DNA", Imperial Cancer Research Fund, London, England, 1968.

"Properties and Possible Role of Satellite DNAs", Oak Ridge National Laboratory, Oak Ridge, Tennessee, 1968.

"Highly Repetitive DNA", Yale University, New Haven, Connecticut, 1968.

"Structure and Function of Repetitive DNA", invited speaker at Conference on Satellite DNA, American Association for the Advancement of Science, Chicago, Illinois, 1968.

"Properties of Guinea Pig DNA", Symposium on Hybridization of Nucleic Acids, Biochemical Society, Newcastle, England, 1968.

"Complementary Strands of Satellite DNAs", Biophysical Society Meeting, Los Angeles, California, 1969.

Participant at Gordon Conference on Cell Structure and Function, Hanover, New Hampshire, 1969.

"Classes of DNA in Mammals", University of North Carolina, Chapel Hill, North Carolina, 1969.

"Structure and Function of Repetitive DNA", Duke University, Durham, North Carolina, 1969.

"Satellite DNAs in Rodent Species", University of Chicago, Chicago, Illinois, 1969.

"Synthesis of DNA Following Alkylation", Temple University, Philadelphia, Pennsylvania, 1970.

"Repetitive DNA", Case Western Reserve University, Cleveland, Ohio, 1970.

"Repetitive Sequences of Higher Organisms", University of Nebraska, Lincoln, Nebraska, 1970.

"Alkylation of DNA", Biophysical Society Meeting, Baltimore, Maryland, 1970.

"Structure and Function of Mammalian DNA", University of Texas, Austin, Texas, 1971.

"Repair of Human DNA", National Institute for Environmental Health Sciences, 1971.

"Alkylation and Repair of DNA", Oak Ridge National Laboratory, Oak Ridge, Tennessee, 1971.

"Repetitive Sequences of DNA", Brooklyn College, New York, New York, 1971.

"A Gene Mutational Assay in Mouse Cells", North Carolina State University, Raleigh, North Carolina, 1971.

"Lectures on Chemical Mutagenesis", University of Sao Paulo, Sao Paulo, Brazil, 1971.

"Lectures and Demonstrations on Ultracentrifugation", University of Sao Paulo, Sao Paulo, Brazil, 1971.

"Chemical Mutagens in the Biosphere", Environmental Mutagen Society, Washington, D.C., 1971.

"Molecular Mechanisms of Mutagenesis", invited participant in Workshop on Chemical `Mutagens as Environmental Contaminants, sponsored by the Fogarty International Center, Bethesda, Maryland, 1971.

"Lectures on Chemical and Radiation Biology", Winter Biochemistry Course, sponsored by Organization of American States, 1971.

"Structure and Function of Human Chromosomes", National Science Foundation, Boulder, Colorado, 1971.

Chairman of Workshop on "Somatic Cell Mutagenesis", sponsored by National Institute of Environmental Health Sciences, 1972.

"Repetitive DNA, Chromosome Defects and Neoplasia", sponsored by National Science Foundation, Minneapolis, Minnesota, 1972.

"Mutagenesis in Mammalian Cells", Duke University, Durham, North Carolina, 1972.

"Mutagenicity of Hycanthone", University of Sao Paulo, Sao Paulo, Brazil, 1972.

"Gene Mutations at the Thymidine Kinase Locus", John Hopkins University, Baltimore, Maryland, 1972.

"Repetitive Sequences and Neoplasia", University of Minnesota, Minneapolis, Minnesota, 1972.

"Mutagenicity of Chemical Substances", George Washington University, Washington, D.C., 1973.

"Test Systems for Measuring Mutagenicity", Howard University, Washington, D.C., 1973.

"Lectures on Molecular Biology", University of Zurich, Zurich, Switzerland, 1973.

"Mutagenesis and Repair", Swiss Institute for Experimental Cancer Research, Lucerne, Switzerland, 1973.

"Mutagenic Test Systems", Food and Drug Administration, Washington, D.C., 1973.

"Relationship of DNA Repair to Mutagenesis", invited participant to Workshop on Mutagenic Test Methods, sponsored by National Institutes of Health, Research Triangle Park, North Carolina, 1973.

"A Tier System Approach to Mutagen Testing", invited speaker at International Conference on Chemical Mutagens, Asilomar, California, 1973.

"Lectures on Molecular Genetics", Symposium on Molecular Hybridization, Zurich, Switzerland, 1973.

"A New approach to Mutagen Testing", invited speaker at Symposium on Chemical Mutagenesis, Moscow, USSR, 1974.

"Introduction to Toxicology", Chairman of Symposium on Collaborative Studies in Toxicology, sponsored by Society of Toxicology and the Association of Official Analytical Chemists, Washington, D.C., 1974.

"Relevance of Mutagenicity Tests in Toxicology", Saratoga Conference on Molecular Biology and Pathology, Saratoga Springs, New York, 1974.

"Test Systems for Assessing Mutagenic Potential", invited speaker at Symposium on Collaborative Studies in Toxicology, sponsored by SOT and AOAC, Washington, D.C., 1974.

"Use of Gene Mutational Assays as a Model for Risk Assessment", Symposium on Risk Assessment, sponsored by NIH, Wrightsville Beach, North Carolina, 1974.

"Tier System Approach to Mutagen Testing", National Institute of Health, Research Triangle Park, North Carolina, 1974.

"Carcinogenesis and Mutagenesis", Procter and Gamble Co., Cincinnati, Ohio, 1975.

"The Need to Quantify Risk", National Cancer Advisory Board, Bethesda, Maryland, 1975.

"Mechanisms of Mutagenesis", General Foods Corporation, New York, New York, 1975.

"Problems in Carcinogenesis", Worcester Foundation for Experimental Biology, Worcester, Massachusetts, 1975.

Chairman of Workshop for Developing a Document on "Mutagenic Test Procedures", Ocean City, Maryland, 1975.

"Mutagenesis as a Toxicologic Problem", Chairman of Gordon Conference Session on Mutagenesis, Meriden, New Hampshire, 1975.

"Open Meeting on Mutagenesis", sponsored by National Institutes of Health, Bethesda, Maryland, 1975.

"Mutagenic Test Systems", Chairman of Session on Short-Term Test, Symposium entitled, "Toxicology and the Food Industry," Aspen, Colorado, 1975.

Session Chairman, Symposium on In Vitro Mutagenicity Tests, Environmental Mutagen Society, Miami, Florida, 1975.

Workshop on "Principals for Evaluating Chemicals in the Environment", sponsored by the National Academy of Sciences, San Antonio, Texas, 1975.

Open Meeting on Mutagenesis, sponsored by DHEW, Bethesda, Maryland, 1976.

"Carcinogenicity Assays, Problems, and Progress", Gordon Conference on Toxicology and Safety Evaluation, Meriden, New Hampshire, 1976.

"Value of Short-Term Tests in Carcinogenesis", Toxicology Forum, Aspen, Colorado, 1976.

"Presumptive Tests", Symposium on Risk Assessment entitled, "Extrapolation II", sponsored by DHEW, Pinehurst, North Carolina, 1976.

"Programs of the National Cancer Institute", invited speaker on cancer, sponsored by the American Association of Science, Boston, Massachusetts, 1976.

"Assessment of Risks from Carcinogenic Hazard", invited speaker to Symposium on Toxicology, sponsored by Synthetic Organic Chemists Manufacturing Association, Atlanta, Georgia, 1976.

Chairman of Session on Short-Term Tests, Symposium on "Status of Predictive Tools in Application to Safety Evaluation", Little Rock, Arkansas, 1976.

"Relevance of Carcinogenicity Testing to Humans", invited speaker at Origins of Human Cancer Cold Spring Harbor Symposium, 1976.

"Human Genetic Disease Versus Mutagenicity Assays", Symposium sponsored by Pharmaceutical Manufacturers Association, Sea Island, Georgia, 1976.

Open Meeting on Mutagenesis, sponsored by DHEW, Bethesda, Maryland, 1976

"Role of the NCI in the National Cancer Program on Environmental Carcinogenesis", invited speaker at Conference on Aquatic Pollutants and Biological Effects with Emphasis on Neoplasia, New York Academy of Sciences, New York, New York, 1976.

"Genetic Disease in Human and Mutagenic Test Systems", Albany Medical School, Albany, New York, 1976.

"Statistical Problems in Carcinogenesis", University of California, Berkeley, California, 1976.

"Carcinogenesis and Animal Bioassay", Grocery Manufacturers of America, Washington, D.C., 1976.

"Problems and Needs in Assessing Carcinogenicity Data", National Clearinghouse for Environmental Carcinogens, 1976.

"Carcinogenesis and Cancer Prevention", University of Eastern Virginia Medical College, Norfolk, Virginia, 1977.

"Overview of Mutagenesis", Food and Drug Administration, Washington, D.C., 1977.

Workshop on Carcinogenicity of Aromatic Amines and Hair Dyes, International Agency for Research in Cancer, Lyon, France, 1977.

"Strengths and Weaknesses of Current Approaches in Carcinogenesis", session Chairman and speaker on "Federal Regulation of Environmental Carcinogens," Center for Continuing Education, Washington, D.C. 1977.

"Program in Carcinogenesis", Cancer Research Safety, NIH, Dulles Airport, Virginia, 1977.

"Predictive Value of Short-Term Tests", invited speaker at Animal Health Institute, Lake Tahoe, Nevada, 1977.

Open Meeting on Mutagenesis, sponsored by DHEW, Bethesda, Maryland, 1977.

"Risk Evaluation", in the Federal Regulation of Environmental Carcinogens, sponsored by Center for Continuing Education, Washington, D.C., 1977.

"Statistical Considerations of the Dominant Lethal and Heritable Translocation Test", The Washington Statistical Society, 1978.

"Testing: Short-Term", 3rd Toxic Substances Control Conference, Government Institutes, Inc., Washington, D.C., 1978.

"The Degree of Concern as Defined by Short-Term Carcinogenicity Assays", Pharmaceutical Manufacturers Association, Point Clear, Alabama, 1978.

"Short-Term Predictive Tests", Pharmaceutical Manufacturers Association, Lincolnshire, Illinois, 1978.

Chairman of Scientific Review Meeting on the U.S. Environmental Protection Agency Diesel Emission Health Effects Research Program, U.S., EPA, Washington, D.C., 1978.

"Strengths and Weaknesses of Tests for Mutagenesis", Banbury Center of the Cold Spring Harbor Laboratory, Cold Spring Harbor, New York, 1978.

"Detecting and Measuring Carcinogens", Seminar on Government Regulation of Cancer Causing Chemicals, National Center for Administrative Justice, Washington, D.C., 1978.

Workshop on "Chemical Scoring Systems", Interagency Testing Committee (TSCA), San Antonio, Texas, 1978.

"Needs for Regulatory Utility of Short-Term Test Data", International Update on Short-Term Tests, The Toxicology Forum, Washington, D.C., 1979.

"Proposed Application of Short-Term Tests", International Update on Short-Term Tests, The Toxicology Forum, Washington, D.C., 1979.

"Current and Proposed Use of Short-Term Tests", Cosmetic, Toiletry and Fragrance Association, Washington, D.C., 1979.

"Application of Mutagenicity Testing on SOM Food Animal Drugs", Subcommittee on Environmental Mutagenesis, DHEW/CCTRP, 1979.

"Application of Mutagenicity Testing in Cyclic Review of Food Additives", Subcommittee on Environmental Mutagenesis, DHEW/CCTRP, 1979.

"Recent Developments on Sorbate/Nitrite", Tripartite (U.S., Canada, U.K.), Annapolis, Maryland, 1979.

"What is Risk?", International Course on the Detection of Environmental Mutagens, Concepcion, Chile, 1979.

"Status of Regulations and Proposed Regulation Covering Environmental Mutagens", International Course on the Detection of Environmental Mutagens, Concepcion, Chile, 1979.

"Food Safety Guidelines", Tripartite (U.S., Canada, U.K.), Ottawa, Canada, 1980.

"History and Progress in Carcinogenesis", Society of Cosmetic Chemists, 1978.

"Introduction and History of Mutagenicity Testing", Annual Meeting of the American College of Toxicology, 1980.

Mutagenicity and Neoplastic Transformation Assays, Course on "Identification and Quantification of Environmental and Occupational Carcinogenic Risks", sponsored by the American College of Toxicology, 1980.

Lectured on Molecular Mechanisms at the American College of Toxicology's course on "Identification of Environmental and Occupational Carcinogenic Risks." "Introduction and History of Environmental Mutagenesis", Second Annual Meeting of the American College of Toxicology.

"Risk-Benefit Considerations in Toxicology", The Toxicology Forum, 1981 Winter Meeting.

"Trends in Biosassay Methodology", 75th Anniversary of the Food and Drug Act, Sponsored by the Animal Health Institute.

"Relationship Between Science & Regulation", Food and Drug Administration Risk Assessment for Carcinogenic Food Ingredients - EPA, 1982.

FDA Experience with Risk Assessment for Carcinogens in Foods, Food and Drug Law Institute, 1982.

Practical Applications of Risk Analysis, The Food, Drug and Law Institute Conference, 1982.

The Future of Carcinogen Testing: Implications for Food Safety, A Symposium on Food Safety Laws: Delaney and Other Dilemmas, sponsored by Boston University, 1982.

Regulatory Use of Genetic Toxicity, Tests, Society of Toxicology - Mid Atlantic Chapter Meeting on Genetic Toxicology/Predictive or Not, 1983.

Aerosol Spray Adhesives, A Workshop on Principles and Applications of Cytogenetic, Sister Chromatid Exchange, Gene Damage to Problems of Human Health, sponsored by the American College of Toxicology, 1982.

Food and Drug Adminstration Viewpoint on Problem Tumor, Toxicology Forum, Winter Meeting, 1983.

Food-Borne Carcinogens, Second International Conference on Safety Evaluations and Regulations of Chemicals, sponsored by Boston University, 1983.

Carcinogenicity of Hair Dyes, Formaldehyde, Nitrates and Berylliu, Symposium on Interpretation of Epidemiological Evidence, sponsored by International Agency for Research on Cancer, 1983.

Use of Acute Toxicity Studies in the Bureau of Foods, Acute Toxicity Workshop, sponsored by the Food and Drug Administration, 1983.

Critical Issues on Science, Technology and Future, The Brookings Institution, 1983.

Challenge to Animal Testing, Chemical Manufacturers Association, 1983.

Regulatory Significance of Workshop Recommendation on Alternatives to Animal Testing, Workshop on Acute Toxicity Testing - Alternative Approaches, sponsored by Johns Hopkins University, 1983.

Role of Mathematical Models in Assessment of Risk and in Attempts to Define Management Strategy, Safety Assessment: The Interface Between Law and Regulation, sponsored by International Life Science Institute, 1983.

Impact of Short-Term Tests on Regulatory Actions, Conference on Cellular Systems for Toxicity Testing, sponsored by New York Academy of Sciences, 1984.

Requirements of Pre-Market Evaluation, Toxicology Forum, April Meeting, 1984.

Use of Short-Term Tests in Risk Assessment, Workshop on RA/RM: Carcinogenesis, sponsored by Society for Risk Analysis, 1986.

A Regulator's Viewpoint, Workshop on Risk Assessment, sponsored by The Procter and Gamble Co., 1986.

Risk Assessment, Sensitivity Analysis, GMA Technical Committee Food Protection Meeting, Grocery Manufacturers of America, 1986.

Update on Current Approaches in Addressing Threshold of Regulations and DeMinimus Risk, Toxicology Forum, Winter Meeting, 1986.

Toxicity Update on BHA/BHT, Toxicology Forum, Aspen Meeting, 1985.

Food Regulatory Issues, Washington Chemical Society, 1984.

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